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Effect of Adding $CaCO_3$ on Aluminum Alloy Melt Foaming Process

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Metal foam not only has good energy absorption and sound absorption performance, but also has high specific strength and thermal stability, so the amount of its production has increased continuously.

Especially, aluminum alloy foam is very light, its manufacturing cost is low and its productivity is very high.

In the previous studies, when aluminum alloy foam was manufactured by powder metallurgy, TiH_2 was used as a blowing agent and the manufacturing process was two–step thermal decomposition. When aluminum alloy foam was manufactured by the melt foaming, calcium was used as a thickening agent, and TiH_2 or $CaCO_3$ was used as a blowing agent or gas–blowing method was used.

The viscosity of liquid aluminum alloy has a great influence on the manufacturing of aluminum alloy foam. If the viscosity is too low, air bubbles made by decomposition of blowing agent float in the molten alloy and have uneven distribution. On the contrary, too high viscosity makes it difficult for air bubbles to move, which results in big air bubbles. The appropriate viscosity is 5~6Pa·s.

Calcium is very expensive and its density (1.55g/cm^3) is very smaller than that of aluminum alloy, so there are several problems as the melting process is complicated.

And added calcium is more active than aluminum, so it reacts with oxygen in molten aluminum alloy to form CaO easily.

In this paper, we have studied the viscosity increasing and foaming characteristics of molten aluminum alloy by $CaCO_3$ (hexagonal crystal structure, density 2.71g/cm^3) addition to manufacture aluminum alloy foam (Al–5%Cu–1.0%Mn–0.2%Ti, density 2.76g/cm^3) by melt foaming.

Using $CaCO_3$ in comparison with TiH_2, air bubbles are uniform and manufacturing cost of aluminum alloy foam is low. But gas–generating ratio of $CaCO_3$ is smaller than TiH_2, so if only $CaCO_3$ is used as a blowing agent, its content gets more. Therefore, if $CaCO_3$ and TiH_2 are added, generating ratio of decomposition gas gets more and air bubbles in the foam get uniform.

The purities of $CaCO_3$ and TiH_2 powders used in experiment were more than 99.6wt% and 99.0wt%, and average sizes of their grains were 20μm and 63μm.

First we manufactured the precursor of aluminum alloy foam and made it as a rod having a certain size, and then foamed it on a stainless steel vessel in heating furnace.

The foaming temperature and holding time were determined by the porosity calculated as the percentage of the density difference between aluminum alloy and its foam.

The viscosity of molten aluminum alloy was measured by the VT–04 viscometer.

As a result, when foaming was done at 780°C for 15 min after the precursor was made by $CaCO_3$ 1.3wt%, TiH_2 0.6wt%, stirring 760°C, stirring speed 500r/min, stirring time 300s, its density was 0.49g/cm^3 and the porosity was 82%. This aluminum alloy foam has good shock–relaxation performance and may be used as a building material.